TECHNICAL MEMORANDUM X-53664

SYSTEMS SAFETY CRITERIA FOR USE IN PREPARATION OR REVIEW OF PROCEDURES

By

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ABSTRACT

Checklists for the preparation or review of various types of procedures are given as guides. The use of the checklists is suggested as a means for insuring that safety features are adequately covered in the procedure.

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INDUSTRIAL OPERATIONS

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SUMMARY

Suggested checklists for insuring systems safety features for the preparation or review of procedures are given for various areas of launch, operating, test, checkout, maintenance, handling, calibration, and ordnance procedures for space vehicles.

INTRODUCTION

This handbook is a checklist for those preparing or reviewing procedures such as those outlined in Apollo Program Directive 26-A. Its use during the preparation of procedures will materially assist the writer, save time, and help ensure the production of an adequate procedure.

Poorly written or unclear procedures are one of the major causes of accidents and incidents in space vehicle operation. Investigations of numerous incidents show that just such procedures were being used. In other cases, procedures did not exist at all.

Inadequate procedures represent as great a threat to space vehicle safety as do faulty hardware and careless work. A well-prepared procedure leaves no doubt in the mind of the person following it. Nothing is left to imagination or guess. Values and units are spelled out, and no step is omitted because it is "obvious." Instructions are clear and concise and the use of special test equipment is specified when required. A proper procedure is one that has been authenticated by a responsible individual and checked out against the hardware for which it is intended.

GENERAL

Typical procedures for which these checklists are applicable include:

*Launch	Checkout	Calibration
Operating	Maintenance	Ordnance
Test	Handling	Other

The following areas of such procedures should be given particular attention:

A - Correlation between procedures and hardware

B - Adequacy of the procedure

C - Accuracy of the procedure

D - Adequacy and accuracy of the supporting documentation

E - Securing provisions

F - Backout provisions

G - Emergency measures

H - Caution and warning notes

I - Requirements for communications and instrumentation

J - Sequence-of-events considerations

K - Environmental considerations (natural and induced)

L - Personnel qualification statements

M - Interfacing hardware and procedures noted

N - Procedure sign-off

O - General requirements

Suggested checklists for each of these areas are included in the following pages.

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* Includes: Count Down Demonstration Test (CDDT)
             Flight Readiness TEST (FRT)
             Count Down (CD)

SOME SUGGESTED CHECKLISTS

On the following pages are checklists which are suggested for use to ensure that safety criteria are adequately covered in the preparation and review of all procedures.

Additions or other changes to these proposed lists would be appreciated by the author. They should be sent to Dr. P. T. Farish, Marshall Space Flight Center (I-RM-F), Huntsville, Alabama, 35812

Correlation Between Procedures and Hardware

1 -   Does the procedure contain a statement as to the hardware
configuration against which it was written?   _____

2 —   Does the procedure contain a revision sheet that identifies
each change to the procedure by paragraph number, the
authority for each change (ECP, etc.), and a master
revision letter (number)?   _____

3 -   Does the procedure revision sheet provide for a notation
of the date and the change number by which hardware
changes were incorporated in the system that the pro-   _____
cedure control?

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Adequacy of the Procedure

1 - Is the procedure clear and concise? _____

2 - Is the procedure free from ambiguity which could lead
to wrong decisions? _____

3 - Have the calibration requirements been clearly defined? _____

4 - Have critical redline parameters been clearly defined? _____

5 - Have corrective controls for these parameters been
clearly defined? _____

6 - Have torque values been specified? _____

7 - Are operating limits of relief valves and rupture discs
specified? _____

8 - Are approved bonding and grounding methods for electrical
equipment specified? _____

9 - Are such items as pressure limits, tie downs, safety
distances, or hazards peculiar to this operation
clearly defined? _____

Accuracy of the Procedure

1 - Has the ability of this procedure to accomplish its specified purpose been verified? _____

2 - Are all gages, controls, valves, etc., which are called out in this procedure described and labeled exactly as they actually are? _____

3 - Are all redline limits on gages, etc., limited as they are in this procedure? _____

4 - Are the redline limitations in this procedure exactly what they should be? _____

Adequacy and Accuracy of the Supporting Documentation

1 – Are all supporting drawings, reports, etc., listed in
this procedure? _____

2 – Are all interfacing procedures listed in this procedure? _____

Securing Provisions

1 -   Does the procedure contain adequate securing instructions
for shutdown of stage, GSE, and facilities to return the
hardware to safe standby conditions?   _____

2 -   Do the securing instructions contain step-by-step
operations?   _____

Backout Provisions

1 – Can this procedure put the stage or vehicle in a condition
which could be dangerous? _____

2 – If so, does this procedure contain emergency shutdown
or backout procedures either in an appendix to the
procedure or as an integral part of the procedure? _____

3 – Is the backout procedure or instructions for its use
included at the proper place in the basic procedure? _____

Emergency Measures

1 -   Does the procedure identify possible emergency conditions
      and clearly state the proper reactions to them?   _____

2 -   Is a pre-test briefing on possible hazards included in the
      procedure?   _____

3 -   Are the emergency procedures to be used referenced in
      the correct place in the text prior to initiation of the
      hazardous operation?   _____

4 -   Are the emergency procedures specific and detailed
      step-by-step?   _____

5 -   Do the shutdown instructions cover all systems involved
      such as facilities, GSE, and stage?   _____

6 -   Does the procedure specify the requirements for an
      emergency team for accident recovery, troubleshooting,
      or investigative purposes where necessary , and describe
      the conditions under which the emergency team will be
      used?   _____

7 -   Does the procedure describe the conditions under which
      the emergency team will be restricted from access to
      a hazardous area?   _____

8 – Does the procedure specify the equipment which must be available for emergency use? _____

9 – Does the procedure consider interfaces in shutdown procedures? _____

10 – Does the procedure call out the necessity and method for alerting support functions in the event of an emergency? _____

11 – Does the procedure require that the emergency crew be pre-drilled in the emergency procedures? _____

Caution and Warning Notes

1 - Have caution and warning notes been included in all possible cases leading to hazards? _____

2 - Do the cautions and warnings precede the hazardous events? _____

3 - Are they adequate to describe the potential hazard? _____

4 - Are they separate entries with distinctive bold type? _____

5 - Do they include emergency crew control if needed at specific required steps in the test? _____

6 - Are human-induced hazards identified and described by cautions and warnings? _____

Requirements for Communications and Instrumentation

1 - Are all modes of checkout requiring communication between stations properly covered by detailed pre-planned callout for emergency operation, alerting, shutdown, and personnel evacuation or control? _____

2 - Will loss of communications create a hazard to the hardware? _____

3 - Has an alternate means of communication been provided? _____

4 - Are the alternate means specified in the text of the procedure? _____

5 - Are the above situations flagged by cautions and warnings? _____

6 - Are all communications, including those which are relayed, verified to assure acknowledgement of message and/or proper response? _____

7 - Will the loss of control or monitoring capability of critical functions create a hazard to the hardware? _____

8 - Has an alternate means been provided to regain control or monitoring of the function via alternate circuits? _____

9 - Are the alternate means detailed in the text of the procedure?   _____

10 - Are the above situations flagged by cautions and warnings?   _____

11 - Are specialized sensors or gages required?   _____

12 - Are there redlines on any of the monitored parameters?   _____

13 - Have corrective actions been specified for use when the redline is exceeded?   _____

Sequence-of-Events Considerations

1 – Can any operation in the procedure initiate an
unscheduled or out-of-sequence event?   _____

2 – Could it induce a hazardous condition?   _____

3 – Is it identified by warnings or cautions?   _____

4 – Is it covered by emergency shutdown and backout
procedures?   _____

5 – Are all sequenced steps prescribed in the procedure
sequenced properly and such that they will not contribute to
or create a hazard to the hardware?   _____

6 – Have all steps which, if performed out-of-sequence,
could cause a hazard been identified and flagged?   _____

7 – Have all non-compatible simultaneous operations been
described in detail?   _____

8 – Have these been prohibited by positive callout or
separation in step-by-step inclusion within the text
of the procedure?   _____

Environmental Considerations (Natural and Induced)

1 – Have environmental requirements been specified which constrain the initiation of the procedure or which would require shutdown of the test, once in progress? _____

2 – Have the induced environments (toxic or explosive atmospheres, etc.) been considered? _____

Personnel Qualification Statements

1 – Does the procedure contain a statement relative to the
qualification of test personnel?   _____

2 – Is there a requirement for personnel certification?   _____

3 – Does the procedure require the test conductor to check
the certification of his personnel?   _____

Interfacing Hardware and Procedures Noted

1 -   Have all interfaces been described by detailed callout?   _____

2 -   Have interfacing operating procedures been drawn up
      to ready equipment?   _____

3 -   Where more than one contractor is involved in an
      operation, have proper liaison and areas of responsibility
      been established?   _____

Procedure Sign-Off

1 – Has the procedure been signed off by the proper
personnel ?   _____

General Requirements

1 - Are the procedures set up such as to discourage a shift change during a test?
_____

2 - Where shift changes are necessary does the procedure require a shift overlap and briefing of the new crew?
_____

3 - Do the procedures require time logs to be kept on limited-life components?
_____

4 - Is there mandatory inspection, verification, and system validation required whenever the procedure requires breaking into and reconnecting a system?
_____

5 - Do procedures for pre-testing safety and emergency equipment prior to the time when it is needed exist and are they adequate?
_____

6 - Do the procedures require walk-through or talk-through dry runs?
_____

7 - Have all safety instructions been spelled out in detail to all personnel?
_____

8 - Do the procedures require that all auxiliary equipment and personnel are available and that this be verified?
_____

9 - Do the procedures require pre-checks of supporting equipment to ensure its compatibility?   _____

10 - Are general requirements covering unique operational equipment correct and valid?   _____
[This consists of such items as leak detection systems (including sampling rate) , purge systems (both lines and interstage) , vent streams and vent port locations, fire protection,and personnel escape route.]
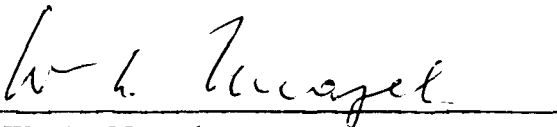
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The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

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